Draft Surface Storage Option Technical Memorandum

Pine Flat Reservoir Enlargement

Prepared for

U.S. Bureau of Reclamation
Mid Pacific Region

By

MWH
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March 2003

Pine Flat Dam and Lake

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SURFACE WATER STORAGE OPTION
TECHNICAL MEMORANDUM

PINE FLAT RESERVOIR ENLARGEMENT
UPPER SAN JOAQUIN RIVER BASIN STORAGE INVESTIGATION

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ACKNOWLEDGEMENTS

The preparers acknowledge the valuable assistance provided by Mr. Roy Proffit, and Mr. Frank Fonseca of the U.S. Army Corps of Engineers Pine Flat Dam office; Mr. Jim Richards of the Kings River Conservation District (KRCD) office at Pine Flat Dam; and Ms. Mary Moore at the U.S. Army Corps of Engineers library in Sacramento.

EXECUTIVE SUMMARY

An appraisal level study of enlarging Pine Flat Reservoir by raising Pine Flat Dam was completed as part of the Upper San Joaquin River Basin Storage Investigation (Investigation). The Investigation is being completed by the U.S. Bureau of Reclamation Mid-Pacific Region, in cooperation with the California Department of Water Resources, consistent with recommendations in the CALFED Bay Delta Program Record of Decision, August 2000.

Pine Flat Dam and Reservoir, located on the Kings River in central California, provides water supply, flood control, hydropower generation and recreation benefits. The dam and reservoir were completed in 1954 by the U.S. Army Corps of Engineers. The reservoir has a total storage capacity of 1 million acre-feet.

This Technical Memorandum considers raising the gross pool elevation of Pine Flat Reservoir by up to 20 feet to increase its storage capacity by up to 124,380 acre-feet. Enlarging the storage capacity at Pine Flat Reservoir would provide an opportunity to exchange water from Millerton Lake with an equivalent amount of water captured by the expanded Pine Flat Reservoir. The first cost of a 20-foot raise is estimated at $44 million.

This Technical Memorandum considers only the engineering and environmental issues associated with raising Pine Flat Dam. Operations studies of a water exchange with Millerton Lake are not described in this document.

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CHAPTER 1. INTRODUCTION

The U.S. Bureau of Reclamation (Reclamation), in cooperation with the California Department of Water Resources (DWR), is completing the Upper San Joaquin River Basin Storage Investigation (Investigation), consistent with the CALFED Bay Delta Program Record of Decision (ROD), August 2000. The Investigation will consider opportunities to develop water supplies to contribute to water quality improvements in and restoration of the San Joaquin River and to enhance conjunctive management and exchanges to provide high quality water to urban areas. The ROD indicated that the Investigation should consider enlargement of Friant Dam or development of an equivalent storage program to meet Investigation objectives.

The Investigation identified several potential surface storage sites to be initially considered through appraisal-level studies of engineering and environmental issues. This document presents findings from an appraisal-level review of the potential enlargement of Pine Flat Dam and Reservoir.

PROJECT DESCRIPTION

Pine Flat Dam and Reservoir are located in Fresno County, near the community of Piedra, about 30 miles east-northeast of Fresno. The dam is located on the Kings River about 20 miles downstream of its confluence with the North Fork of the Kings River (Figure 1-1).

This Technical Memorandum considers raising the gross pool elevation of Pine Flat Reservoir by up to 20 feet to increase its storage capacity by up to 124,380 acre-feet.

EXISTING FACILITIES

Pine Flat Dam is a 429-foot high concrete gravity structure constructed on the Kings River in 1954 by the U.S. Army Corps of Engineers (Corps) to provide flood protection to downstream properties. The dam is owned and operated by the Corps. Its axis is oriented in a north-northwest to south-southeast direction and at a gross pool elevation of 951.5 feet above mean sea level (elevation 951.5), it impounds a reservoir with a volume of one million acre-feet and an area of 5,970 acres. (See Figure 1-2.)

The dam crest at elevation 970.0 is 32 feet wide and 1,820 feet long. Pine Flat Dam has a gated spillway located in the center of the dam with an ogee crest at elevation 916.5. The spillway is 292 feet long and is divided into six 42-foot wide bays. Each bay is equipped with a radial tainter gate 36 feet high and 42 feet wide.

In 1984, Kings River Conservation District (KRCD) constructed Pine Flat Power Plant at the downstream toe of the dam on the right abutment. Pine Flat Power Plant is owned and operated by KRCD. The powerhouse contains three Francis turbines with a total installed capacity of 165 mW.

Wishon and Courtwright Reservoirs are located upstream of Pine Flat Reservoir. The storage capacities are 128,600 acre-feet and 123,300 acre-feet, respectively. Due to their high elevation, these reservoirs have relatively little effect on rain floods. However, they do store snowmelt runoff that might otherwise need to be stored in Pine Flat Lake.

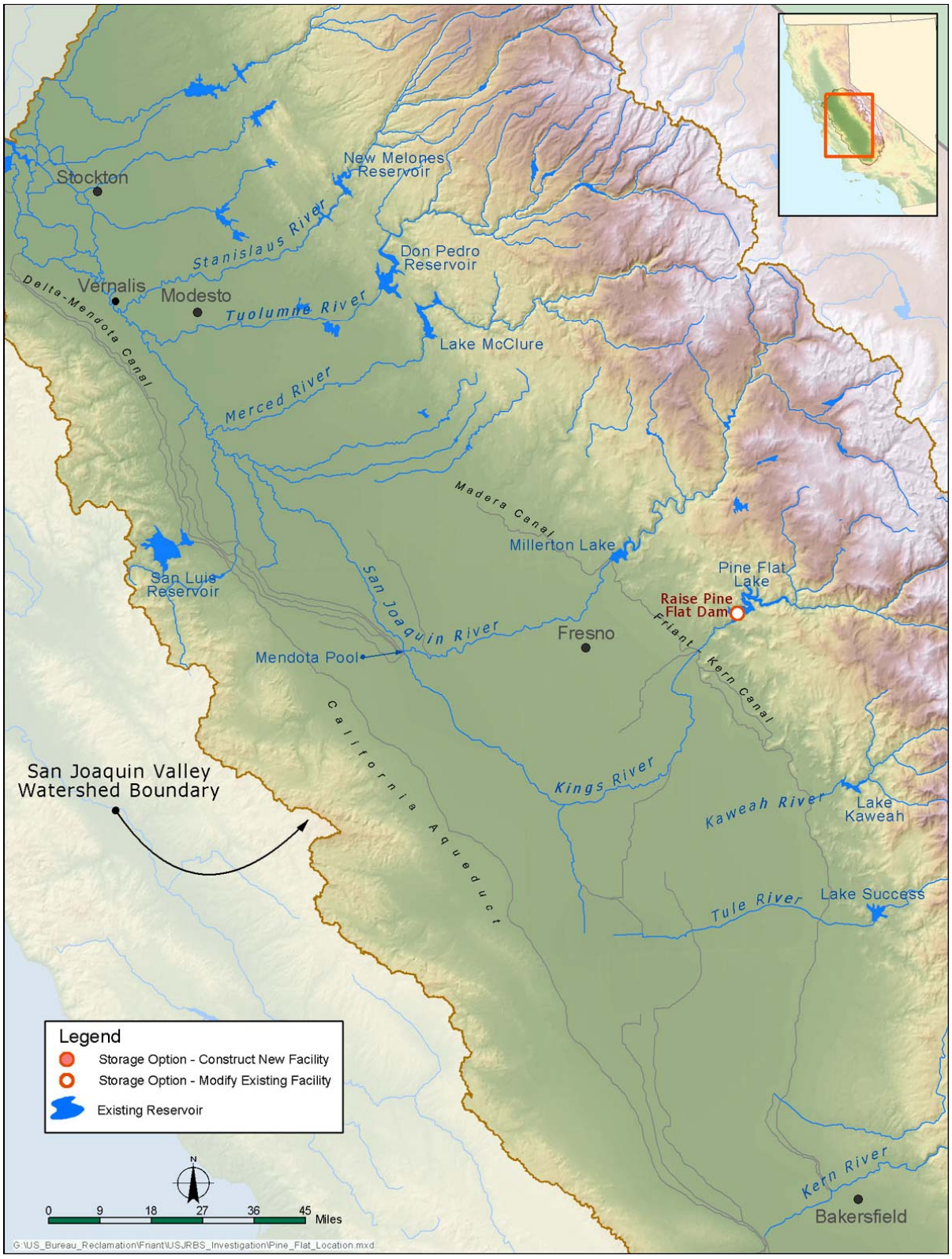

FIGURE 1-1. PINE FLAT RESERVOIR LOCATION MAP

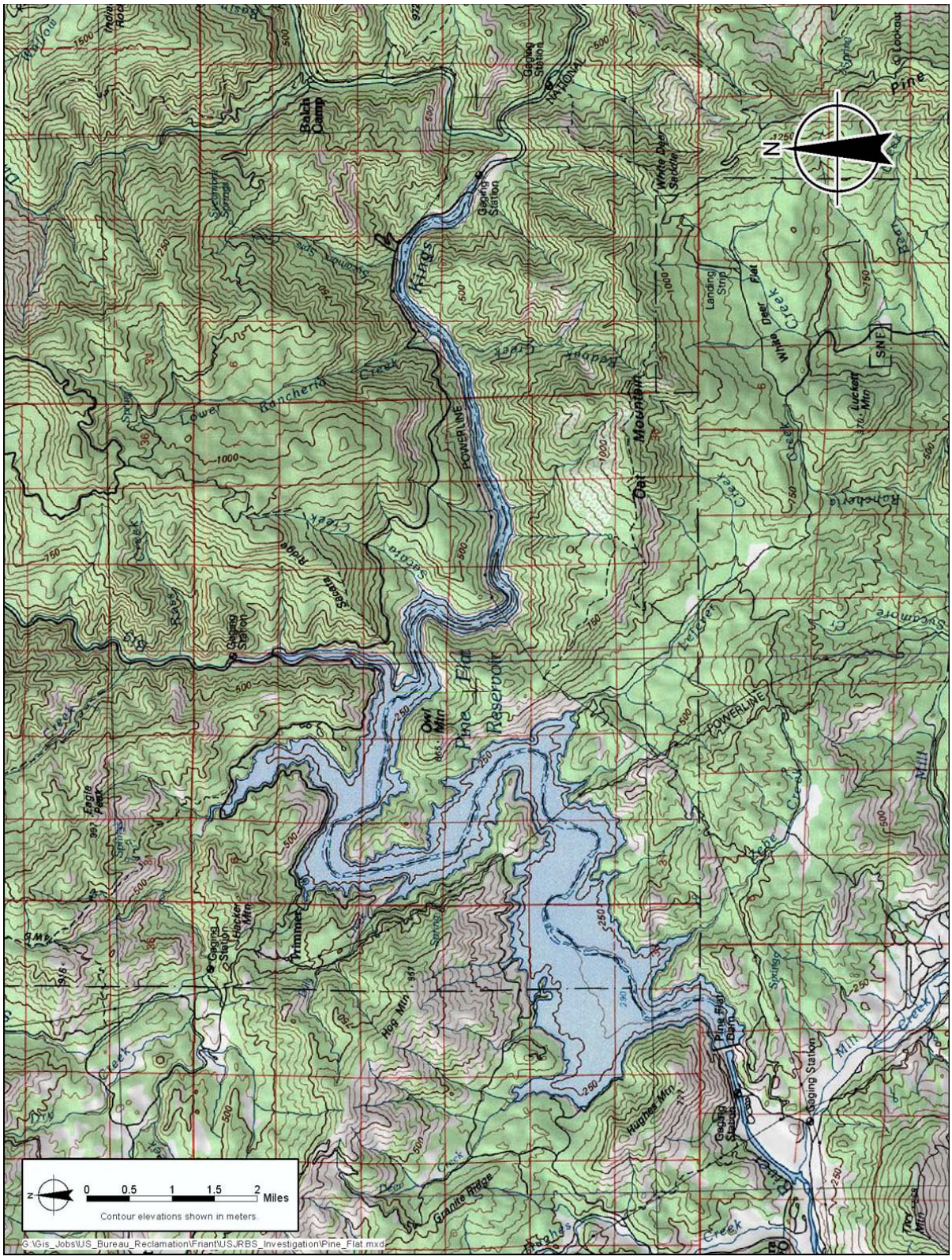

FIGURE 1-2. PINE FLAT RESERVOIR AND VICINITY

Pacific Gas and Electric Company (PG&E) operates three hydroelectric power projects in the Kings River Basin: the Kings River Project, the Balch Project, and the Helms Pumped Storage Project. The Kings River Project consists of the Courtwright and Wishon Reservoirs and the Haas and Kings River Powerhouses. The Balch Project consists of Balch Powerhouses Nos. 1 and 2, a small upstream diversion dam, and an afterbay. The Helms Pumped Storage Project uses Wishon Reservoir as the afterbay and Courtwright Reservoir as the forebay.

The Friant-Kern Canal, part of the Federal Central Valley Project, crosses the Kings River about 8 miles below Pine Flat Dam. There are also numerous flood control levees and irrigation distribution systems downstream of the dam.

SUMMARY OF PREVIOUS INVESTIGATIONS

In 1974, a Master Plan of the Kings River Service Area was prepared for KRCD by International Engineering Company, Inc. (IECO). The purpose of the Master Plan was to recommend a course of action that would: 1) prove a balanced water supply; 2) minimize flood damage; and 3) conserve and develop water and power resources. One of the alternatives evaluated consisted of a 20-foot raise of Pine Flat Dam and Reservoir. It was one of four economically feasible alternatives retained as viable. IECO concluded that a staged development of the four recommended alternatives be pursued.

In 1976, the Corps prepared a Master Plan, Design Memorandum No. 7 (DM No. 7) to guide resource use and development over the life of the Pine Flat project in order to protect and to further enhance the scenic, biologic, and recreational resources of the area. The Master Plan was intended to maximize the recreational benefits and enjoyment of Pine Flat Reservoir.

In 1989, the Corps prepared a Reconnaissance Report describing a study to investigate flood control and water related resource opportunities associated with Pine Flat Dam. A number of measures were evaluated, including enlarging Pine Flat Reservoir. Both 15- and 20-foot raises of Pine Flat Reservoir were considered, which would increase storage capacity by 92,772 acre-feet and 124,380 acre-feet, respectively.

In 1989, the Corps prepared an Environmental Assessment (EA) - Reconnaissance Study for Flood Control to determine if raising the gross pool of Pine Flat by 20 feet would result in any significant environmental impacts. Based on the analysis and coordination with concerned agencies, organizations, and individuals, it was concluded that significant impacts would result, and that an Environmental Impact Statement (EIS) would need to be prepared during the future feasibility planning stage. The report concluded that, although local support was present, there was no Federal interest in a potential solution to local and regional water resources problems. The report recommended that no further Federal action be taken at that time.

In 1994, the Corps produced a reconnaissance report on potential fish and wildlife habitat restoration measures, including a 15-foot raise of Pine Flat Reservoir. Reservoir enlargement would have allowed a higher minimum reservoir elevation to be maintained, with potential benefits for a coldwater fishery. The report, a basis of design, provided information on water resources in the study's area, environmental problems, and the potential environmental benefits, impacts, and costs of five restoration measures, along with reconnaissance level

details on operations, civil designs, and real estate requirements. The report made no recommendations regarding measure selection.

The Corps' December 2001 Final Feasibility Report and EIS/EIR (revised in May 2002 and again in June 2002) describes in detail a recommended plan for fish and wildlife habitat restoration. The recommended plan, now awaiting congressional authorization, involves a multilevel intake structure to manage the temperature of releases from Pine Flat Reservoir plus other habitat restoration actions at Byrd Slough, located along the Kings River immediately south of the Friant-Kern Canal siphon. The feasibility report documents how the recommended plan evolved from the five measures considered in the 1994 Basis of Design, while the EIS/EIR provides a detailed environmental analysis of the selected plan and other final alternatives considered. The 15-foot raise of Pine Flat Reservoir was not carried forward to the feasibility phase for inclusion in alternative restoration plans principally because of cost and adverse effects.

PROPOSED IMPROVEMENTS

Raising the gross pool elevation of Pine Flat Reservoir by 20 feet, from the present elevation of 951.5 feet to elevation 971.5, would increase storage capacity by 124,380 acre-feet. The project would include raising the dam crest 12 feet and replacing the 36-foot high spillway gates with 59-foot high gates. The dam crest would be raised from elevation 970.0 to elevation 982.0 by adding reinforced concrete and pre-stressed tendons to the downstream face of the dam. The existing ogee spillway would be reshaped and the piers enlarged and strengthened. The hoist works, for the power plant intake trash racks and stop logs, would have to be raised, as well as the service elevator.

As a consequence of these modifications, the PG&E King River Power Plant, located along the upper reaches of Pine Flat Reservoir, would need to be raised 21.5 feet. The KRCD Pine Flat Powerhouse, at the toe of Pine Flat Dam, would also require reconfiguration.

APPROACH AND METHODOLOGY

This Technical Memorandum was prepared from a brief review of the previous reports mentioned above, an engineering field reconnaissance on June 13, 2002 (Appendix A), and an environmental field reconnaissance of the dam and reservoir area on May 29, 2002 (Appendix B).

During the June 2002 field trip, engineers and geologists examined the site under consideration. Locations of existing and proposed structures were visually assessed. Topography, geology, geotechnical conditions, and utilities were noted. Access routes were considered, as well as possible borrow, staging, and laydown areas.

During the environmental field visit, specialists in botany, wildlife, aquatic biology, recreational resources, and cultural resources visually assessed existing environmental resources. Additional research was conducted, making use of prior studies and available literature, the California Natural Diversity Database, topographic maps, and aerial photographs. This information was used to determine the extent to which potential environmental impacts might constrain the storage options under consideration. Where evident, opportunities for improving environmental resources or mitigating adverse effects

were also noted. Surveys were not conducted and consultations with external resource management or environmental agencies were not held.

The seismotectonic evaluation conducted by Reclamation for this study was based on readily available information and is considered appropriate for appraisal level designs only. Detailed, site-specific seismotectonic investigations were not been conducted, nor were aerial photographs or other remotely-sensed imagery evaluated. More detailed, site-specific studies would be required for higher-level designs.

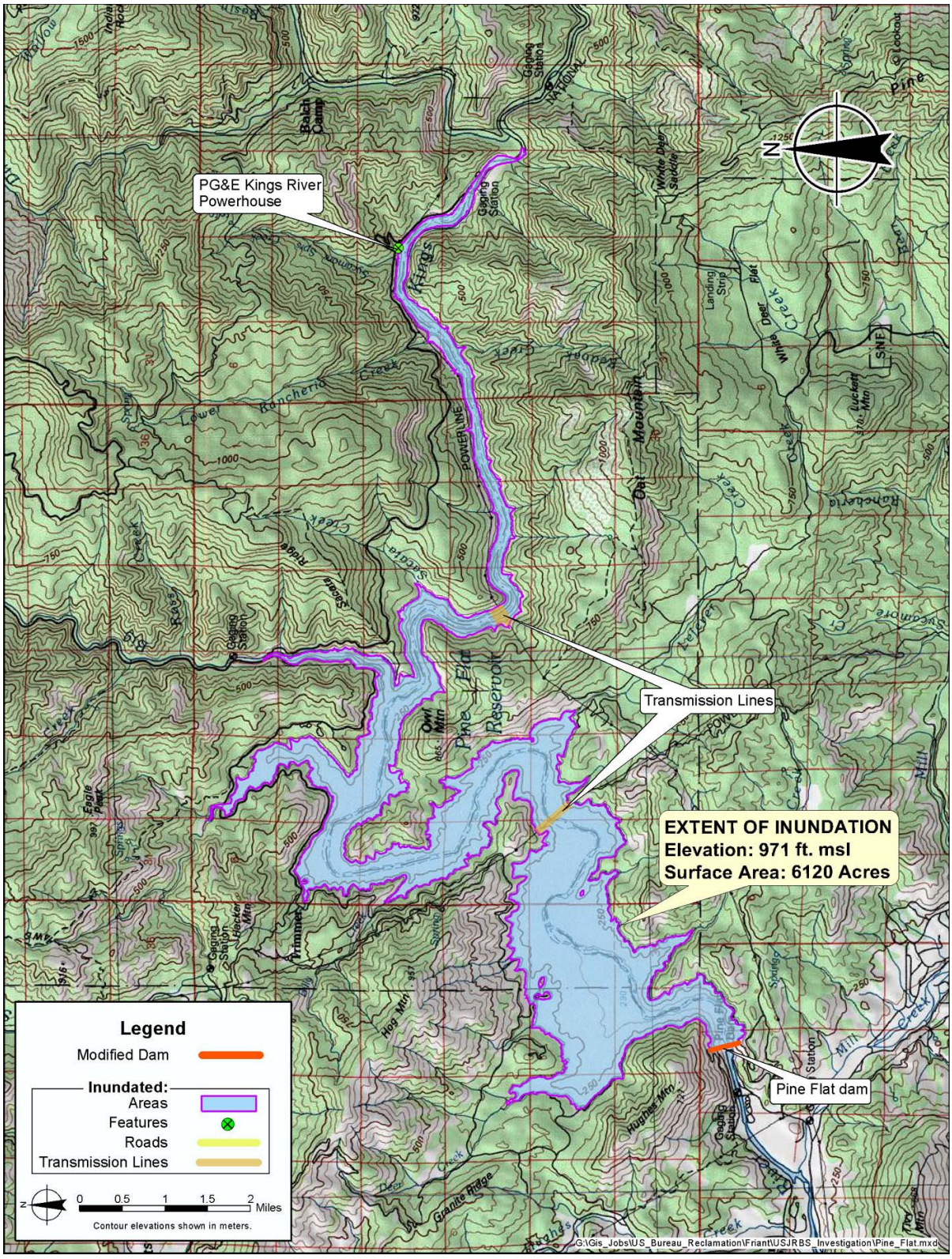

FIGURE 1-3. PINE FLAT RESERVOIR ENLARGEMENT INUNDATION MAP

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CHAPTER 2. TOPOGRAPHIC SETTING

TOPOGRAPHY

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Elevations in the immediate vicinity of Pine Flat Dam and Reservoir range from about elevation 600 to nearly elevation 2,400.

Farther east, the terrain steepens and the canyons become more incised. The canyons have been cut by southwest- to west-flowing rivers and associated large tributaries. The Kings River is the main river in the area. The topography of the Kings River basin is the most rugged in the entire Sierra Nevada, rising to over elevation 14,000 in the upper watershed.

The existing dam is located in a section of river that passes through a narrow, west-southwest trending bedrock canyon. The right abutment slope rises steeply (1.5:1 horizontal to vertical ratio) to the crest of Hughes Mountain. The left abutment slope rises at a similar inclination, with a 1.7:1 horizontal to vertical ratio.

AVAILABLE TOPOGRAPHIC MAPPING

Publicly available topographic mapping of the study area is from the U. S. Geological Survey (USGS). It is likely that additional, and potentially more detailed, topographic maps of the reservoir and dam site are held by the Corps and KRCD.

AVAILABLE AERIAL PHOTOGRAPHY

Aerial photography of various scales and imagery is available from the archive files of the U.S. Geological Survey. Additional aerial imagery may also be available from the U.S. Department of Agriculture, Reclamation, and the Corps. A specific search of the available photography was not conducted for this Technical Memorandum nor was any aerial photography reviewed.

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CHAPTER 3. GEOLOGIC AND SEISMIC SETTING

REGIONAL GEOLOGY AND SEISMICITY

The Pine Flat Dam and Reservoir project area is located near the boundary of the Sierra Nevada Geomorphic Province and the San Joaquin Valley portion of the Great Valley Geomorphic Province. The Great Valley basin is filled with thick accumulations of marine (at depth) and non-marine sediments shed largely from the Sierra Nevada mountain range. Recent alluvium of lake and river origin blanket most of the present-day surface, while dissected remnants of Pleistocene alluvial fans rim the valley margin.

The Kings River basin is within a complex geologic area containing pre-Cretaceous meta-sedimentary and meta-volcanic rocks that have been folded, faulted, and intruded by granitic rocks of three different ages. Volcanism, followed by glaciation and recent stream down cutting, have modified the topography to essentially the present day landscape. Major geologic structures trend to the northwest. Bedding and foliation of the rock units typically strike northerly and dip steeply west. The degree of weathering and jointing varies by rock type.

Overall, potential seismic hazard potential at the site is low. Preliminary earthquake loading analysis, for this appraisal-level evaluation, considered two types of potential earthquake sources: fault sources and areal/background sources.

Twenty-two potential fault sources were identified. They included those associated with the San Andreas fault, seven western Great Valley faults, seven eastern Sierra Nevada faults, the White Wolf fault of the southern San Joaquin Valley, and six faults of the Sierra Nevada Foothills system. No major through-going or shear zones have been identified in this area of the Sierra Nevada and historic seismicity rates are low.

The areal/background seismic source considered was the South Sierran Source Block (SSSB), the region surrounding the project site. This region possesses relatively uniform seismotectonic characteristics.

Probabilistic seismic hazard analysis shows that the peak horizontal accelerations to be expected at the site are 0.13g with a 2,500-year return period, 0.17g with a 5,000-year return period, and 0.23g with a 10,000-year return period.

SITE GEOLOGY AND FAULTING

Pine Flat Dam and Reservoir are located near the boundary of the Sierra Nevada foothills and the Great Valley. The state geologic map (CDMG, 1966) shows that the area to the north of the lower part of the reservoir is a complex of geologic units comprising pre-Cenozoic meta-volcanic and meta-sedimentary rocks, and Mesozoic granitic, basic intrusive and ultrabasic rocks. The south side of the lower end of the reservoir is composed of pre-Cenozoic granitics, and the upper reaches of the reservoir are made up of Mesozoic granitics.

Pine Flat Dam is situated on hard metamorphic (meta-volcanic) rock consisting primarily of jointed amphibolite with scattered seams of calcite, quartz and lesser occurrences of gypsum.

No significant through going fault zones are known to exist within the area.

SITE GEOTECHNICAL CONDITIONS

Typically, rock at the damsite is hard, dark gray, fine grained and brittle. Thin seams of gypsum and deeply weathered joints were encountered on the right abutment during construction of Pine Flat Dam. These seams are not expected to present a significant foundation problem for raising the dam.

Several landslides were observed downstream of the dam. These landslides appeared to be wedge failures occurring along weak remnant bedding planes in the metamorphic rock mass in conjunction with sub-vertical joint sets.

CHAPTER 4. HYDROLOGIC SETTING

DRAINAGE AREA

The Kings River watershed upstream of Pine Flat Dam covers approximately 1,700 square miles, ranging from about elevation 600 at Pine Flat Dam to elevation 14,000. The Kings River has three primary branches, the North, Middle, and South Forks.

RAINFALL

Rainfall in this Mediterranean climate region varies from about 8 or 9 inches per year in the valley to about 60 inches per year in the Sierra Nevada. About 90 percent of runoff-producing precipitation occurs during the months of November through April.

Precipitation usually occurs as rain at elevations below 4,000 feet and as snow at higher elevations. Snow has occurred in the San Joaquin Valley, though, and rain sometimes occurs at elevations above 10,000 feet. The snow pack accumulates during the winter and early spring and generally starts melting in April. The April to July runoff at the Piedra stream gaging station, just downstream of Pine Flat Dam, accounts for an average of about 75 percent of the total annual runoff.

EROSION, RUNOFF, AND RECHARGE

Specific information on soils and erosion potential at the site was not identified. It is expected that the soils in the Kings River basin could be broadly classified into two types. The first type consists of shallow, well-drained, slightly acidic, rocky, medium textured soils, developed on slates, schists, volcanic debris, and serpentine bedrock. Soils of this type are reasonably stable with adequate vegetation.

The other soil type would be moderately deep, moderately coarse-textured, well drained, slightly acidic, and granitic. Soils of this type are subject to severe erosion. Farther southwest along the Kings River, the flood plain area would consist of moderately deep, nearly level to gently rolling well-drained loams underlain with hardpan.

Steamflow data has been collected at gaging stations in the Kings River basin by the USGS, the Corps, and local agencies for a varying number of years. The stream gage at Piedra has been in operation since 1895, providing the longest continuous set of flow data available. The average annual volume for the Kings River at Pine Flat Dam is 1,587,900 acre-feet.

AVAILABLE FLOOD DATA

Detailed flood data were not identified in the documents reviewed. There are two types of flood flows on the Kings River - winter rain floods and spring snowmelt floods. The winter rain floods, which occur from November through March, are caused by heavy rains and are characterized by sharp, high peaks of short duration and comparatively small volumes. The snowmelt floods occur during the period from March through June. While not producing the high peak flows of winter-type floods, they have a much larger runoff volume.

The history of flooding in the Kings River basin extends to 1895. Flood years were 1966, 1969, and 1978. The snowmelt in 1966 was 290 percent of normal. The snowmelt in 1969 exceeded all previous recorded years. Flood control releases to the San Joaquin River in 1969 totaled 1,017,000 acre-feet. Pine Flat Dam was operated to control outflow to a maximum of 17,100 cubic feet per second (cfs) (COE, 1989a).

Over the past 48 years, Pine Flat Dam has not provided the high degree of flood protection that was originally intended. This is due to the unanticipated precipitation and runoff in the Kings River Basin, which included the largest 30-day inflow of record (1986) and the largest snowmelt of record (April through July 1969).

Based on recent trends toward greater precipitation and runoff in the Kings River Basin, investigations show that flood-producing storms greater than those of the past are expected to occur in the future. Three of the most severe rainfloods during the 85-year period 1895 to 1980 have occurred since Pine Flat Dam was completed, and water-year runoff has exceeded the 85-year mean 11 times. Due to the increased development over the years, the more recent floods have caused substantial damage to roads and bridges, homes, businesses, public utilities, recreational facilities, and highly developed agricultural land.

CHAPTER 5. ENVIRONMENTAL SETTING

INTRODUCTION

This chapter describes existing environmental resources at the site and qualitatively describes potential effects of reservoir enlargement, indicating the extent to which expected or potential environmental effects might pose a constraint to the development of surface storage. Where evident, opportunities for improving environmental resources or mitigating adverse effects have been noted. The analysis concentrated on botany, terrestrial wildlife, aquatic biology, recreational resources, cultural resources, and existing land uses. Mining and other known past activities that might affect site conditions are also briefly discussed, along with the potential presence of hazardous or toxic materials. Temporary construction related disruptions and impacts are discussed in Chapter 6.

The identification of constraints was conducted at a preliminary, appraisal level of planning, consistent with the current phase of the Investigation. Criteria considered were based, in part, upon criteria commonly used to evaluate environmental impacts of projects under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The application of criteria that may be used for NEPA or CEQA evaluation does not imply that the analysis is at a level that would be needed for an Environmental Impact Statement or Environmental Impact Report. Considerations included: presence of special status species (e.g. Federally listed endangered species), species of concern, or sensitive habitats; relative amounts of affected riparian or wetland habitat; effects on native or game fish; conflict with established recreational uses or land uses; presence of nationally registered historic places, sacred Native American sites, or traditional cultural properties; permanent disruption or division of established communities; and loss of energy production facilities.

BOTANY

Overview of Existing Conditions

Annual grassland, foothill woodland, and chaparral habitats are found in the area around Pine Flat Dam and Reservoir. Some riparian vegetation is found along the shores of the reservoir, but occurrences that are more extensive are found upstream on the Kings River and in some tributaries, particularly Big Creek and Deer Creek. Seeps and other seasonal wetlands are likely to be present as well.

Only five special-status botanic species were reported in the California Natural Diversity Data Base (CNDDB) in areas surrounding Pine Flat Reservoir: orange lupine, tree-anemone, American mannagrass, Madera linanthus, and Kings River buckwheat. Of these, only the tree-anemone is listed by the state or federal government as threatened or endangered, and three have California Native Plant Society (CNPS) List 1B status. The closest known location of the tree-anemone, which is listed by the State of California as a threatened species, occurs in the upper reaches of Big Creek east of Barnes Mountain. However, habitat for the tree-anemone occurs elsewhere in the watershed, and surveys may be required to determine its presence or absence. Suitable habitat for the three List 1B species probably occurs in the watershed, possibly outside the proposed new pool elevation.

Portions of the affected area are on serpentine soil. Although the CNDDB does not indicate the presence of serpentine dependent species in this area, surveys would be necessary to confirm their presence or absence.

Constraints

The primary botany related potential constraint to enlargement of Pine Flat Reservoir would be the loss of riparian and wetland habitat. The exact amount of habitat loss associated with a 20 foot raise in the reservoir's maximum water surface elevation is unknown. However, a 15 foot raise would flood riparian and shaded riverine aquatic habitat for ¾ of a mile up the Kings River, for approximately one month in 20 percent of the years. It would also periodically inundate nearly 300 acres of oak woodland, oak savannah, and non-native valley grassland (COE 2001). An incremental amount of additional habitat would be periodically inundated by a 20 foot raise. It is possible that special-status species could pose a constraint, but it is unlikely.

Opportunities

Opportunities to improve vegetation at the site or mitigate for habitat loss are uncertain. Habitat losses are likely to be small and there may be some possibility of on-site mitigation.

WILDLIFE

Overview of Existing Conditions

An increase in the Pine Flat Reservoir pool would result in loss of upland foothill woodland habitats and inundation of the terminal points of tributary streams. The foothill woodland habitat hosts a diverse wildlife community but has a small deer population. Golden eagles are known to occur in the Pine Flat area, as are spotted bats. Foothill yellow-legged frogs and western pond turtles inhabit some tributary streams; four streams are reported to have populations of pond turtles. Valley elderberry longhorn beetles, a federally listed threatened species, are also present throughout the area.

Constraints

The area surrounding the Pine Flat Reservoir is remarkably devoid of special status wildlife species for such a large area. The loss of tributary stream habitats for foothill yellow-legged frogs and western pond turtles would require further investigation to determine the extent of potential constraints. The loss of valley elderberry longhorn beetle habitat would require mitigation.

Opportunities

Since Pine Flat Reservoir has potentially fewer constraints posed by special status wildlife species, this site would offer a less encumbered opportunity for development than other sites of similar size.

AQUATIC BIOLOGY/WATER QUALITY

Overview of Existing Conditions

The Pine Flat Reservoir basin is steep-sided and the reservoir has limited shallow, vegetated shoreline habitat for fish. Large annual water level fluctuations presumably contribute to the degradation of the habitat value of the shoreline.

Pine Flat Reservoir was thermally stratified in the summer of 1976 and dissolved oxygen concentrations approached zero near the bottom in the previous fall and winter (KRCD, 1977). Since the reservoir is deep and relatively narrow, with cold-water inflows from the Kings River, it probably stratifies every summer.

Rainbow trout and white catfish are the principle fishery species in Pine Flat Reservoir. Threadfin shad and golden shiner (*Notemigonus crysoleucas*) provide the prey base for these fisheries. White bass (*Morone chrysops*) was recently illegally introduced to the reservoir and is now considered a nuisance species by the California Department of Fish and Game (DFG). The principal concern is that white bass could enter the San Joaquin River during flood flows and make their way to the Sacramento-San Joaquin Delta, where they would compete or prey on native species. Kern brook lamprey are found in the Kings River upstream of the reservoir, as are wild rainbow trout (COE 1994).

Constraints

This measure would entail raising the maximum pool elevation of Pine Flat Reservoir by 20 feet. Such a small raise would have little effect on aquatic biological resources or water quality, particularly given the large size and depth of the existing reservoir. The increase in water level would result in upstream inundation of the Kings River and a loss of some valuable fish habitat, especially for wild rainbow trout and Kern brook lamprey. Although the exact amount of habitat loss associated with a 20 foot raise is unknown, a 15 foot raise would flood riparian and shaded riverine aquatic habitat for ¾ of a mile up the Kings River, for approximately one month in 20 percent of the years (COE 2001).

Opportunities

If inundation of upstream shaded riverine aquatic habitat created adverse effects on the Kings River fishery that needed to be mitigated, mitigation could be difficult. Conversely, however, an increase in water level elevation would also produce a modest increase in reservoir fish habitat, probably leading to minor increases in fish production. In addition, warm water species could benefit from the inundation of terrestrial vegetation and increased reservoir volume could improve temperature conditions for coldwater fish such as trout (COE 1994).

RECREATION

Overview of Existing Conditions

Pine Flat Reservoir is a major low elevation recreation destination, which provides a variety of water oriented recreation opportunities including pleasure boating, water skiing, fishing and swimming. Lands surrounding Pine Flat Reservoir are used for camping, picnicking, and hunting. An average of over four million visitor hours are recorded annually. Fishing and boating are the primary activities during spring. Hunting and fishing predominate during fall and winter (COE, 1989b).

Pine Flat Reservoir covers 5,950 surface acres and has 67 miles of shoreline, most of which is steep sided (KRCD, 1977). The south side of the reservoir is undeveloped and accessible only by boat. Trimmer Springs Road, a paved county road, provides access to the north shoreline. A number of developed recreation facilities are present along the north shore and the river just upstream of the reservoir, as shown in Table 5-1.

TABLE 5-1
RECREATION FACILTIES IN THE VICINITY OF PINE FLAT RESERVOIR

Facility	Description
Lake Ridge Marina	Boat launching and mooring
Deer Creek Recreation Area	Boat launching, day use, camping
Island Park Recreation Area	Boat launching, day use, camping
Lakeview Recreation Area	Boat launching, day use
Trimmer Marina	Boat launching and mooring
Trimmer Recreation Area	Boat launching, day use, camping
Sycamore Flat 1 Campground	Day use, camping (no lake access)
Sycamore Flat 2 Campground	Day use, camping (no lake access)
Lakeview Recreation Area	Day use, camping (no lake access)
Kirch Flat Campground	Camping, day use, whitewater boating take out

Lodging and other services are available at various locations around the lake, including near Island Park and Lakeview.

In addition to the facilities described above, several developed recreation facilities are present downstream of Pine Flat Dam on the Kings River. These include: Pine Flat Recreation Area, Choinumni Park, Winton Park, and Avocado Lake Park. These developed areas offer overnight camping, picnicking, and fishing access.

Pine Flat Recreation Area is located one half mile downstream of the dam, accessible by Pine Flat Road via Trimmer Springs Road (KRCD 1977). Fresno County Parks and Recreation Department (FCPRD), under license to the Corps, operates this 174-acre area. This area is divided into two parts: one west of Piedra Road, designed for overnight and day use, and the other, east of Piedra Road and closer to Pine Flat Dam, designated as day use only. The eastern part receives heavy use by picnickers (KRCD, 1977).

Choinumni Park is on the north side of the Kings River, about 2½ miles downstream of Pine Flat Dam. This 170-acre park, with day use and overnight facilities, is owned and operated

by FCPRD. Winton Park and Avocado Lake Park, further downstream, would probably not be affected.

The North Fork of the Kings River and the main stem of the Kings, just upstream of Pine Flat Reservoir, provide various day use and overnight opportunities such as hiking, fishing, picnicking, swimming, wading, and dispersed and developed camping. In addition, both the North Fork and the main stem Kings River are popular whitewater boating destinations, and support both private and commercial use. Boaters typically put in at Garnet Dike Campground and take out at Kirch Flat Campground. This run, referred to as Garnet Dike Run or Banzai Run, is 10 miles long and ranges in difficulty from Class III to Class IV, depending on flow. Commercial outfitters have set up base camps along this reach of the river to accommodate their boating operations.

Constraints

Raising the water surface elevation 20 feet would also inundate all or portions of the existing developed recreation facilities. Exceptions are Sycamore Flat 1 and 2 Campgrounds and the Lakeview Recreation Area. These sites are situated upslope, away from the shoreline. It may be difficult to move some of these facilities further upslope owing to relatively steep terrain surrounding the reservoir.

Raising the water surface 20 feet would also inundate the Kings River upstream of Pine Flat Reservoir. According to the Corps report, this measure would flood base camps for several commercial rafting outfitters (COE, 1989b). It would also inundate Karch Flat Campground, the preferred take out for private boaters. Raising the water surface elevation 20 feet would inundate about one mile of rapids, impacting rafting and trout fishing opportunities.

Opportunities

According to the Corps, raising the gross pool elevation 20 feet would increase the lake surface by approximately 355 acres. The additional surface area would create new water oriented opportunities and create demand for new facilities. Appropriate facilities would include additional boat launch areas, campsites, and day use areas.

Any facilities that are inundated should be replaced in kind, or with improvements to other recreation facilities in the area to accommodate increased use.

CULTURAL RESOURCES

Overview of Existing Conditions

The territory of the Choynimni Foothill Yokuts extended up the Kings River to the vicinity of Pine Flat Dam. The majority of Southern Valley and Foothill Yokuts people now live on the Tule River Indian Reservation, near Porterville. The upper reaches of present-day Pine Flat Reservoir, from Trimmer upstream, are within the traditional territory of the Wobonuch people, Numic-speaking relatives of the Northfork Mono along the San Joaquin River. Like the Northfork Mono, the Wobonuch lived in small settlements along larger watercourses. Wobonuch descendants live primarily in Dunlap, southeast of Pine Flat Reservoir (Spier

1978a:426-427). The Holkoma Mono people, not discussed by Spier, presently live at Cold Springs Rancheria about ten miles north of Trimmer.

Pine Flat Reservoir was surveyed as part of a Smithsonian Institution River Basin Surveys program, begun in 1947 (Drucker 1948a). Details on this work are presently unavailable, as is information regarding subsequent studies.

Pine Flat Dam was constructed in 1951 through 1954. Specific information is presently unavailable regarding other aspects of Pine Flat area history. A variety of sites are likely to be present, associated with mining, logging, reservoir development, recreation, residential development, and other activities.

Constraints

Numerous cultural resources are known to be present, and there may be additional resources not yet recorded. Inundation of archaeological sites (prehistoric or historic) can result in loss of important scientific data. A potential reservoir raise of 20 feet might affect additional properties. No properties eligible for the National Register of Historical Places are known to be present, but future study may identify such properties. No Native American sacred sites or Traditional Cultural Places (TCPs) are known to occur, but Wobonuch and Holkoma Mono concerns are expected.

Opportunities

Inundation damage to archaeological sites can be mitigated with scientific data recovery programs. Reservoir projects also provide an opportunity for public interpretation of the past. Ancillary project facilities, such as roads, power lines, or other structures, may provide opportunity for avoidance of impact to archaeological sites through design or facility placement.

LAND USE

Overview of Existing Conditions

The only facilities that may be affected by this measure would be the PG&E Kings River Power Plant, penstock, and the associated transmission line at the eastern end of the reservoir.

Constraints

The PG&E power plant, located in the upper reaches of Pine Flat Reservoir, would need to be raised 21.5 feet. No other constraints were identified.

Opportunities

Because the 20-foot raise would not disrupt an existing community, this measure is considered an opportunity for making land use improvements.

MINING AND OTHER PAST ACTIVITIES

Beyond those referred to above under cultural resources and recreation, no evidence of mining or other past human activities that could affect the site were identified.

Constraints

No constraints related to past uses that could affect the site have been identified, except those previously discussed above.

HAZARDOUS AND TOXIC MATERIALS

Overview of Existing Conditions

Recreational properties in the reservoir area may possess, or may have once possessed underground or above ground storage tanks for petroleum hydrocarbon fuels or lubricants. Depending on the type of operation, electrical transformers containing polychlorinated biphenyls (PCBs) may also be or have been present in the project area.

Constraints

Potential impacts to the site requiring remediation from fuel and lubricant hydrocarbons, and from electrical transformers may exist within the project area.

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CHAPTER 6. STORAGE STRUCTURES AND APPURTENANT FEATURES

ZONED EARTHFILL EMBANKMENT DAM

In 1989, the Corps evaluated options for increasing Pine Flat Reservoir's gross pool elevation by 15 and 20 feet. The Corps determined that the 15-foot raise would result in 92,772 acre-feet of additional storage. Work to raise the gross pool 15 feet would include:

- Raise dam crest 7.0 feet to elevation 977.0;
- Reshape the spillway ogee;
- Enlarge the spillway piers;
- Install new 42-foot wide x 54-foot high tainter gates;
- Raise the upstream PG&E Kings Power Plant 16.5 feet, from elevation 958.0 to elevation 974.5;
- Relocate 3.5 miles of Trimmer Springs Road, including three bridges;
- Raise hoist works for the power plant intake trash racks and stop logs and elevator at Pine Flat Dam;
- Relocate inundated recreation facilities where possible; and
- Mitigate for impacts to fish and wildlife.

A 20-foot raise in the gross pool elevation of Pine Flat Reservoir would result in 124,380 acre-feet of additional storage. Work to raise the gross pool 20 feet would include:

- Raising dam crest 12 feet to elevation 982.0;
- Reshaping spillway ogee;
- Enlarging spillway piers;
- Installing new 42-foot x 59-foot tainter gates;
- Raising upstream PG&E Kings Power Plant 21.5 feet from elevation 958.0 to elevation 979.5;
- Adding reinforced concrete with pre-stressed tendon to the downstream face of the dam;
- Relocating 3.5 miles of Trimmer Springs Road, including three bridges;
- Raising hoist works for the power plant intake trash racks and stop logs, and elevator at Pine Flat Dam;
- Relocating inundated recreation facilities where possible; and
- Mitigating fish and wildlife impacts.

A typical cross section of the proposed dam raise was not provided in the 1989 Corps report.

RESERVOIR ELEVATION VS CAPACITY

A reservoir elevation versus storage volume curve is shown in Figure 6-1.

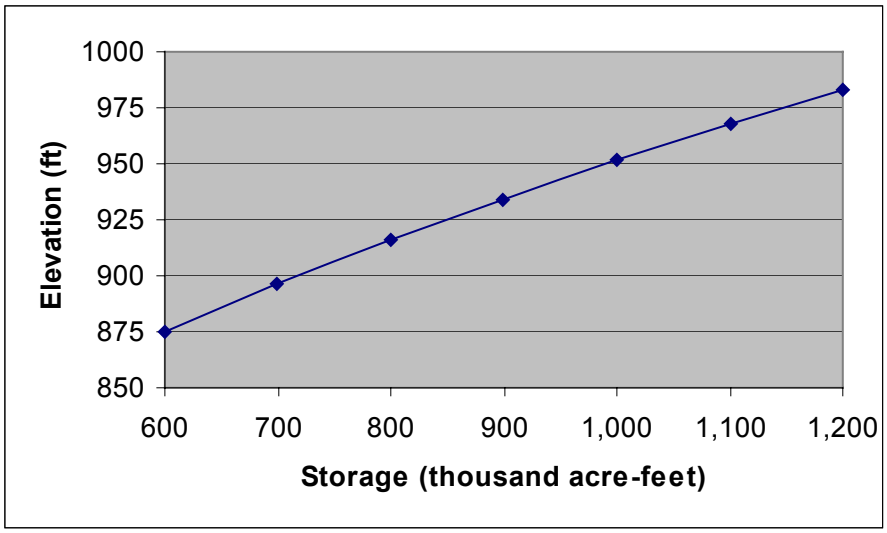

FIGURE 6-1. ELEVATION VS. CAPACITY CURVE

CONSTRUCTABILITY

Land, Right-of Way, Access, and Easements

Public roads lead to the Pine Flat Dam and Reservoir area. Overhead and underground utilities lead to and service the dam as well as the area below the dam. A number of high voltage transmission lines traverse the area. One line traverses the ridge south of the dam and reservoir; others cross the Kings River just downstream of the dam and downstream of Piedra; another crosses the central portion of the reservoir; and one exits southward from the KRCD power plant and the PG&E power plant.

Borrow Sources/Materials

Alluvial river gravel, suitable for processing into concrete aggregate, is available along the banks of the Kings River and lower Mill Creek Valley immediately downstream of Pine Flat Dam. Reportedly, these river deposits were previously investigated by Reclamation and the Corps, and a sufficient quantity exists to meet the needs of any proposed scheme for raising the dam (IECO, 1974). Furthermore, it was reported that plans are being made for developing a quarry in the granitic rock of nearby Jesse Mountain (COE communication, 2002).

Foundations

The foundation of the raised portion of Pine Flat Dam would be in hard, sound amphibolite. Care must be taken during foundation excavation of the abutments to ensure stability of the cut slopes above the dam on each abutment.

Power Sources

Nearby electrical power is available from the Pine Flat generating unit.

Staging and Lay Down Area

Potential staging and laydown areas are available within the parking area on the downstream side of the left abutment and at the bottom of the dam crest access road, near the Corps office.

Contractor Availability and Resources

There are several local general contractors capable of performing the rock excavation and concrete work necessary to raise the dam. Installation of post-tension tendons, fabrication and installation of gates, raising the intake gate frames and elevator, would probably have to be contracted to specialty firms outside the immediate region.

Construction Schedule and Seasonal Constraints

It is anticipated that all construction activity necessary to raise the dam could be carried out over a period of one year. Seasonal constraints include the winter rainy season between late October and May, and spring floods that can occur between April and June due to snowmelt. The reservoir level during construction would have to be maintained at a suitably low elevation to avoid damage to construction activities by potential floods.

Flood Routing During Construction

Floods would be stored in the drawn down reservoir during construction, and flows routed through the powerhouse.

Environmental Impacts During Construction

Environmental impacts during construction could be mitigated with proper planning and implementation of best management practices. The work site is remote from urban development. Visual impacts would thus be minimal and noise would affect few humans. Air quality issues can be mitigated by dust control measures for quarry, material processing, and construction on the dam. Any blasting that might be required on the abutments will require both noise and vibration monitoring on the dam. A cultural survey would have to be conducted to identify any ancestral American Indian or historic artifacts and construction activities would be restricted in those areas. Bald eagle sightings have been made within the reservoir area. Importing concrete aggregate from distant plants may cause traffic impacts but with proper planning and coordination with Caltrans, the major impacts could be

mitigated. All construction equipment should have spark arresters and fire control equipment would need to be kept readily accessible during construction. Construction water would have to be controlled as well as provisions made for runoff and erosion control. A spoil control plan would be needed to control any construction related fuels, lubricants, and other materials.

Permits

Federal and non-federal sponsors would be proposing the dam raise. This joint sponsorship would complicate the permitting process somewhat as federal projects are not subjected to the same level of permitting that is required for non-federal projects.

Given the probable duality of sponsorship, and potential environmental and cultural impacts identified, at a minimum the following permits and permitting agencies may become involved:

Permit	**Permitting Agency(ies)**
Permit to Construct	FERC, DSOD, Fresno County
Encroachment	CALTRANS, Fresno County
Air Quality	CARB, Fresno County
Low/No Threat NPDES	RWQCB
Waste Discharge	RWQCB
401 Certification	SWRCB
Blasting	Fresno County
Stream Bed Alteration	CDFG
Fire/Burn	CDF, Fresno County

In addition, the following agencies could be involved in the review of permit conditions:

- Bureau of Indian Affairs
- Bureau of Land Management
- State Historic Preservation Office
- Advisory Council on Historic Preservation
- U.S. Fish and Wildlife Service

In obtaining these various permits, several plans would have to be prepared, submitted to the responsible agencies for review and approval. Some of these include:

- Construction Plan and Summary Documents
- Quality Control Inspection Plan
- Highway Notification Plan
- Blasting Plan
- Noise Monitoring Plan

- Water Quality Monitoring Plan
- Noxious Weed Control Plan
- Bat Protection Plan
- Management Plan for Avoidance and Protection of Historic and Cultural Properties
- Storm Water Pollution Prevention Plan
- Spill Prevention/Containment Plan
- Visual Quality Control Plan
- Dust Control and Air Quality Plan

Another important regulatory requirement involves compensation/mitigation for habitat loss. In October 1998, the U.S. Fish and Wildlife Service (FWS) issued their draft Coordination Act Report and Habitat Evaluation Procedure (HEP Analysis). The HEP Analysis delineates how compensation for adversely affected baseline habitat and wildlife conditions is to be determined.

In addition, if power generation is included in a project or is modified for an existing project, the Federal Energy Regulatory Commission (FERC) may become involved in the permitting process.

APPURTENANT FEATURES

No new conveyance, outlet or spillway facilities would be required for raising Pine Flat Reservoir.

COSTS

Construction Costs

Based on the 1974 IECO study, a cost estimate for the proposed Pine Flat Dam raise was updated to April 2002 price levels using Reclamation Construction Cost Trends. Costs were also modified to reflect current component costs and standards of practice, especially with respect to seismic requirements.

The estimated total first cost for the proposed 20 foot raise of Pine Flat Reservoir is $44 million. Estimated cost components are presented below in Table 6-1 and in Appendix C. Field costs represent the estimated cost to construct identified features, plus provisions for unlisted items (15 percent), contingencies (25 percent), and mitigation (5 percent). Land costs are excluded from this appraisal-level estimate, as are costs for relocating or modifying affected power plants. Additional study of these requirements would be needed to determine their costs. Total project costs include field costs plus estimated costs for future analyses and planning documentation, development of designs, and construction management (15 percent).

TABLE 6-1
PROJECT FIRST COST ($ MILLIONS)

Component	20-Foot Pool Raise
Dam, Spillway, Gates	$24
Permanent Operating Equipment	$1
Unlisted Items	$4
Contingency	$7
Mitigation	$2
Total Field Cost	$38
Invest/Design/CM	$6
Total Project First Cost	**$44**

Operation and Maintenance Costs

Operation, maintenance, and replacement costs have not yet been estimated for the Pine Flat raise. These will be estimated by applying representative figures based on a review by Reclamation of other similar projects and agency guidance. However, it is expected that operations and maintenance costs would be only slightly higher than presently expended for Pine Flat Reservoir.

SYSTEMS OPERATIONS

Preliminary Corps operations studies of the enlarged Pine Flat Reservoir with a storage volume of about 1,124,000 acre-feet, proposed that all new space be devoted to flood control.

To benefit the San Joaquin River or CVP water users, water from Millerton Lake would be exchanged with an equivalent amount of water captured by the expanded Pine Flat Reservoir.

CHAPTER 7. HYDROELECTRIC POWER OPTIONS

PUMPED STORAGE CONSIDERATIONS

The proposed raise of Pine Flat Reservoir does not involve pumped storage.

ADDED HYDROELECTRIC POWER TO EXISTING STRUCTURES

In general, the Pine Flat Power Plant would be operated at higher heads for longer periods of time and would therefore generate more power. The Kings River Power Plant on the other hand, would be inoperable at certain times of the year when the reservoir level is too high, unless the facility is moved to a higher elevation.

NEW HYDROELECTRIC POWER

The project would not develop any new hydroelectric power sources.

TRANSMISSION AND DISTRIBUTION

No information is available on transmission and distribution of potential additional power developed from the hydroelectric projects associated with raising Pine Flat Reservoir.

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